VOL. 6 NO. 3

AMERICAN JOURNAL OF OPTOMETRY

ROBERT MINTURN LOCKWOOD

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Robert Minturn Lockwood, Jr., son of Robert Minturn Lockwood and Eliza Ann Lewis came into this interesting old world, he would have said, March 21st, 1857, and left it on the great adventure February 16th, 1920. Though his birth took place in New York City his life and work were to influence Optometry on a world-wide scale.

His boyhood was spent with an uncle in Newburg, N. Y., where he attended the public schools but early showed signs of being gifted in mathematics and precociously interested in applied science; it was his ambition to attend the Rensselaer Polytechnic Institute but he was prevented by lack of sufficient means. Instead he followed his father's course in working in the electrical manufacturing business, becoming associated with the independent telephone companies, at that time rivals of the Bell Telephone Company. He worked in New York and in Boston.

Later he entered the employ of the Bell Telephone Company, who in 1882 when he was 25, sent him to South America to install Bell telephones in Rio de Janeiro, Brazil.

Here he met Miss Ellen Dean, of St. Louis, Mo., to whom he was married in Buenos Ayres, Argentine Republic, September 1st, 1882.

In 1883 at Rio de Janeiro he suffered a most severe attack of yellow fever which seriously affected his health during the remainder of his life. This forced him to leave Brazil and he settled with his family at St. Louis, Missouri.

He continued in the electrical manufacturing business until 1888 when he and his wife opened a private school in which he taught mathematics until his wife's death, in 1898, broke up the school.

What was denied him he secured for his son, Dean Putman Lockwood, Ph.D., who is a graduate of Harvard University and at present librarian and professor of Latin at Haverford College. He

found a deep and abiding joy in his boy's success, deeper and more abiding because it was success along this cherished course.

In 1900 he moved to Chicago and became business manager of The Jenner Medical College. Here, also, he taught physics and Medical Latin. He was an accomplished linguist but this fact was usually overlooked in the glare of his later brilliant success as a technical writer in Optometry. Here he was deeply interested in medicine and had he been given the opportunity of becoming a physician he would have made an ideal one, a man of the Osler type, an ever-serious student, a natural-born teacher, a level-headed practitioner, an inspiring, sympathetic friend.

Call it luck, chance, destiny, fate or what you will, medicine missed him and Optometry gained him and while medicine will never comprehend his loss, Optometry can very readily evaluate what she would have lost had his work not been contributed. At a critical point in his development he influenced for good every department, education, legislation, organization, wherein he quietly and unostentatiously laid down the fundamental principles that now form the cornerstone in the foundation upon which Optometry is rearing so imposing a structure.

At the Jenner Medical College he met Dr. H. M. Martin, one of its professors who had launched many into Optometry and was advised by him to study Optometry. While pondering this advice he talked it over with one of the students, Earl J. Brown, now known to almost everyone in Optometry, who lent him the books which impressed him sufficiently to cause him to devote the remainder of his life to Optometry. Of the many good deeds carried out for Optometry by Dr. Brown he may justly count this one of the finest, albeit it was done without consciousness of the ultimate significance.

His knowledge of mathematics added to his newly acquired knowledge of optics won for him a professorship at the Northern Illinois College of Ophthalmology and Otology where, incidently, he earned his Opt. D. degree. His duties here included supplying technical articles to the college-owned magazine, *The Focus.* When that was absorbed by *The Optical Journal and Review* he was retained by the latter.

In 1902 private affairs necessitated a visit to New York City which was thought would be of short duration. He was detained and in order to fill in his spare time he began to write a book from the material embodied in his lectures at the Northern Illinois College. This was the widely known *"Principles of Optometry."* It is a classic.

He decided to remain in New York City and gave part of his time to private practice, part to teaching and part to editorial work. He never enjoyed the business details that inevitably accompany successful private practice and he more than willingly relinquished the pecuniary advantages thereof and devoted himself mainly to

editorial work on the new magazine known as *"The Optical Journal and Review of Optometry,"* a weekly that had absorbed *The Focus,* the old monthly *Optical Journal, The Scientific Optical Instrument Monthly* and *The Review of Optometry,* another monthly.

He was one of that hard-working group who taught for years at the New York Institute of Optometry from which were graduated many of the men now the outstanding figures in optometry. This group, working as a perfectly functioning team, each strong in his own department, established a new and higher standard in optometry and Professor Lockwood was the outstanding "teacher" even in that group. Who of all those who studied under him or worked beside him will ever forget him as he stood, so characteristically, before his big blackboard with his meter stick, his colored chalks, his big chalk-compasses and his glue-pot and cardboard models—actually making the study of theoretic and applied optics a fascinating pursuit!

That suggests his most outstanding characteristic, namely, a scrupulous avoidance or perhaps an inherent abhorance of showiness or pose. Those closest to him never caught one word or one gesture that carried him over the line of the modest and sincere seeker of scientific truth. No glittering generalities for him but plain, unvarnished truth presented in the simplest, clearest, and, above all, most understandable style.

A casual observer might have thought that Professor Lockwood did not receive proper credit for his work but none could think that who ever witnessed the keen joy that beamed from his countenance when some piece of apparatus he had constructed, perhaps out of the simplest materials, proved successful in demonstrating a principle. Then what finer praise could an author ask than to have edition after edition of his works exhausted and each new book acclaimed with louder enthusiasm and assimilated with greater avidity.

Aside from hundreds of lectures before classes and societies and hundreds of articles in his own and other journals he wrote *Principles of Optometry; Subjective Tests for Difficult Cases; The Trial Case and How to Use It; Transpositions, Frames and Lenses, and Skiascopy Without Drugs.*

Most unfortunately death prevented his finishing what would have embodied the results of his vast experience and learning, *The Art of Ocular Refraction,* the first part of which had been published serially. No one has filled the gap.

It was he who edited all the matter on optometric subjects which appears in Funk and Wagnall's *Standard Dictionary* where he was a departmental editor for years.

Professor Lockwood was one of the five charter members of the New York Academy of Optometry who saw with the writer the need for and future use of such a body which was to sound a new note in optometry and which established the proper foundation, in this Acad-

emy principle, for the building of a professional optometry capable of coping with the demands that were sure to be made upon it in the interests of better vision. It was before this body that some of his best lectures were delivered. About the last work he did was done here and is embodied in his famous exposition of *The Cross Cylinder* and that stands today as the most complete and authentic technique for the application of this ingenious device.

An insight into the kindness of his nature may be had through the following incident: A member of his household was hard of hearing and often failed to hear the ringing of the door bell; he arranged in each room at a point where the gaze would be most likely to fall a wooden figure that tipped with the ringing of a bell, indicating through sight the ringing that could not be heard. Not only is this an instance of his innumerable, thoughtful kindnesses but it is a typical example of his practical, common sense way of meeting problems.

In 1910 he married Miss Rose Green, who from its inception had been connected with *The Optical Journal and Review* and who passed with it through its many vicissitudes, and it was evident to all who saw any part of their home life that theirs was an ideal union. He lived only ten years after this marriage but these were very happy years. His and his wife's tastes were simple and easily satisfied and it is pleasant to note that his editorial work and his royalties placed him beyond those pecuniary worries that had harassed his early ambitions.

Prejudices did not bind him; intellectually he was fearless—no Gascon in ready praise of himself but inwardly he might have said:

"I carry my adornments on my soul.
I do not dress up like a popinjay;
But inwardly I keep my daintiness.
* * * * *
I go caparisoned in gems unseen,
Trailing white plumes of freedom, garlanded
with my good name.
* * * * *
A soul clothed in shining armor, hung
With deeds for decorations.
* * * * *
A bristling wit, and swinging at my side
courage, and on the stones of this old town
Making the sharp truth ring, like golden spurs."

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STEREOSCOPIC FUSION TREATMENTS

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Few subjects, bearing upon the Profession of Optometry have, within the past five years, been given more consideration than Muscle and Fusion Training. Without nerve action first, we know there will be no muscle movement and, to have and maintain that most desired result of vision, namely, Fusion, perfect co-ordination of the extrinsic ocular muscles must prevail. In spite of recent development and newly constructed instruments we should not forget that a group of leading men were doing muscle work for the last twenty years and more. Dr. D. W. Wells has expounded a course of procedure which has been proven, by time and experience, quite successful, provided both patient and refractionist are exercising the necessary patience essential to muscle training. This paper has much to do with this procedure. In another article I wish to discuss and, as far as possible, explain the process of muscle neuricity with the myoculator.

The human eye is a dynamic physiologic instrument as thoroughly active as the brain it serves, subject to many changes of physiological and psychological origin, and not a mere static refracting instrument or medium.

Visual efficiency depends upon three main requisites, namely:

1. Sharp macular perception.
2. Single binocular vision (Fusion).
3. Perfect balance of the extrinsic ocular muscles in co-ordination with the intrinsic or accommodative muscles.

The sharp macular perception may be fulfilled through accommodation as in hyperopia, or with lens correction, partly or wholly.

Single binocular vision is, however, a quite complicated mental performance, dependent upon the physical, physiological and psychological status.

When an object creates an image on corresponding points on the two retinae in readiness to be seen as single, it is a purely physical condition. The monocular field of vision for each eye has its limits through anatomical interference of orbit and nose, but is extended farther to the temporal than the nasal side. The field of single

binocular vision is the overlapping portion of these two monocular fields. The nerve fibers of conjugate retinal points, since they can be defined, terminate in intimately associated neurons in the right and left occipital cortices.

The peculiar anatomical arrangement of the course of the retinal nerve fibers greatly assists this condition. The fibers from the temporal left and the nasal right meet in the left occipital lobe and those from the right temporal and the left nasal meet in the right occipital lobe, after semi-decussation of all fibers has taken place in the chiasm.

The second condition is wholly dependent upon the combined action of the twelve extrinsic ocular muscles in order that the two eyes may be so directed that the image of an object thus fixed may fall upon corresponding points of the two maculae. This condition and the nerve supply for this muscle activity will be considered more closely later on.

The third condition is one of rather a psychological nature. Our eyes view a world of various dimensions, in everyday use. Since it has depth, images of objects at various distances cannot be focused on corresponding points of our retinae and still we do not see these various objects double, regardless of whether we look directly at objects far or near. When you look directly at a man across the street, geometrically speaking, you should see one double who may be standing in the middle of the street, but you have been taught by experience that this is not so and you see him single. If I place a stereoscopic picture in the holder before the phoroptor I can turn in something like 20 degrees of prism, and stereoscopic vision will still be maintained and the patient's eyes will hardly follow the prism apex. This faculty, purely psychological, is extremely important and is certainly worth training.

The anatomical condition cannot be changed and in cases where it is inclined to be impaired, as in strabismus, it becomes a serious menace to perfect fusion. We must apply training in the second and third conditions, namely, the co-ordination of the extrinsic muscles and the fusion sense.

Research

We must look into and map out the nerve supply for the extrinsic ocular muscles of the eyes before we can determine upon a course of training for them. Let us experiment a little in doing so we will at once be shown two kinds of nerve supply of a vastly different kind. Just demand of a person that he change his line of vision in any way that you may indicate which is against his wish or will and you cannot force him to do so. To do this, therefore, is a matter of his own volition. He will do so or not just as he wills it. Therefore, the changing of one's line of fixation is principally a volitional act and the conscious mind controls the rotation of the eyes through nerve centers sending neuricity to the muscles that rotate them.

On the other hand, you will find that every person will maintain

single binocular vision within certain limits unconsciously. For example, by placing a 3Δ prism before one's eyes base-out, geometrically, we would cause diplopia, but instantly we turn our eyes in, and restore single binocular vision. This act is not volitional, but just the reverse, for we could not maintain diplopia without decided effort. This eye motion, turning in, is an involuntary act and controlled by the fusion sense.

In Dr. E. C. Savage's mental diagram he shows the brain centers controlling the movements of the eyes. The nerves and the muscles they control are represented in the following manner: The left internus and the right externus are controlled by one cortical brain center, thus controlling the movement of the eye toward the right, and the right internal and left external recti are controlled by another cortical brain center and control the movement of the eye towards the left.

We have orthophoria when, in a state of perfect rest, the visual axes of the two eyes are parallel, and the tonicity of each muscle with that of its antagonist is perfectly balanced. Rotate such a pair of eyes and a state of perfect balance still continues since the control of the flow of neuricity to each pair of muscles is from one cortical brain center, we can safely assume that each of these muscles receives an equal amount. If this was actually true the fusion sense would not be appealed to in the maintenance of single binocular vision.

Savage also shows that we have the basal brain centers acting only under the control of the fusion faculty of the mind in addition to the cortical brain centers which control any voluntary movement of the eyes as shown above. Each of the twelve extrinsic eye muscles is connected by nerves with one of these basal brain centers. It can thus readily be seen that should the tonicity of these muscles be unequal and so disturb the balance or equilibrium as with diplopia the basal brain center of the muscles so erring or lagging will at once act and supply the needed neuricity in order that perfect balance may be retained and single binocular vision be maintained.

Since the desire for fusion is fundamental, is basic and is maintained only by action of the extrinsic muscles functioning in perfect equilibrium we must know that our hope for altering the tonicity of any of these muscles, found to be faulty, we must do so by disturbing fusion and thus induce the flow of neuricity from the basal brain centers to the particular muscles we desire to exercise. Thus reasoning we at once learn the way to reach the basal brain centers alone with our course of training. It is imperative that accommodation and the cortical brain centers supplying volitional neuricity to the eyes be at rest.

The fusion sense cannot be developed unless we train or school the following vital factors upon which it depends—namely—good visual acuity—concurrent binocular vision— fusion range and fusion quality, that is, acute visual discernment and stereoscopic vision.

In considering the above factors it is well to think of amblyopia

ex-anopsia as suspension of vision or blindness due to continued suspension, due to non-use and not toxic amblyopia. We have presented to us two theories regarding squint which are conflicting. One of these is, that the lack of fusion develops strabismus and following this is suspension of the brain image of the diverting eye. Crediting this idea we would then attribute all strabismus to the absence of fusion sense.

In the other theory it is claimed that strabismus is due to the effects of hypermetropia. Excessive accommodation with convergence demand remaining normal, disturbing accommodative convergent relation and a tropia in some form, incident to fatigue, results, followed by suspenopsia and terminating in amblyopia, and, in rare cases, in amblyopia without strabismus.

The latter of these theories appears the more rational to me and more in agreement with my own and the experiences of many other refractionists with whom I have consulted and whose writings I have read.

Strabismus and Amblyopia

Every case of strabismus would be hopeless and incorrigible, should the optometrist accept the theory first advanced. We could never expect to bring a pair of eyes to single binocular control where there is an utter lack of fusion sense and if we knew that this sense could not be taught after passing the sixth year, even though we should succeed in improving or even restoring, to normal, the visual acuity in the amblyopic eye. Upon demanding binocular vision one of the eyes would be diverted, uncontrollably, from its binocular position and so would soon again become amblyopic. A tenotomy, for cosmetic purposes alone, would be the alternative. Many cases of strabismus, however, will, in time, correct themselves upon being fitted with proper plus lenses alone, if taken in early life, but proper treatment will, of course, hasten results. Is it not true also, that we can restore, to normal, many cases of strabismus in those of even mature years. It is a fact there are cases, apparently recovered, which will drop back again into an amblyopic condition, within various lapses of time, due entirely to carelessness and neglect. The ever present watchfulness of the refractionist is demanded with these and prudence calls for at least semi-annual checks of such cases.

Treatment of Amblopia Ex-Anopsia

To literally force the eyes to see is the treatment for amblyopia ex-anopsia as its own name indicates. There are various methods of procedure according to experiences and judgment of the refractionist. I have had excellent results as an initiative step by flashing a moderately strong light alternately into the affected eye, in rhythmic repetition, while patient is seated in a dark room, thus causing an awakening of the retina, and as soon as a visual acuity of approximately 20/200 has been acquired the light is flashed upon smaller letters and characters until 20/60 can be seen, then occlusion of the good eye, constantly if possible, and, if not, as long as patient will tolerate.

Walton's celluloid discs are good or in fact any means by which the good eye is completely occluded. The vanity of the patient has much to do with the act of occlusion. If patient is literate set for him the task of transcribing 200 words daily and presenting this written exercise to you daily. Small children may be given interesting exercises in play and games such as blocks, games, matching letters, pictures, etc., thus removing the odium of being treated for a bodily ill. As soon as possible have patient complete courses of reading in fine print assigned to him.

In a few instances amblyopia will be present with the absence of deviation. Such cases are the exception. In these cases care must be taken to prevent deviation and in the course of our training it is desirous to induce fusion-simultaneous binocular vision. To explain, we will assume that a point of visual acuity of say 20/60 or 20/50 has been gained. Patient will see very well with that eye so long as he is urged to use it, but if he attempts to use both together, as he may think he can do, we will note a constant suspanopic condition of the defective eye usually periodic at first and, if neglected, the condition will again relapse into a permanent one. It is necessary to combat this suspenopsic condition since the fusion sense cannot control single binocular vision so long as it prevails. For this purpose the Worth-Black amblyoscope is well adapted. Pictures are held in two tubes, and are complimentary as to results. For instance, one should see the bird in the cage, the mouse in the trap, the boy riding on his dad's back, etc. While one could not place this particular lot of pictures under the fusion list, since the two retinal images are not alike, yet the fusion sense must be brought into place to satisfy the non-fusion or volitional sense. The volitional sense wants to place the mouse in the trap, the bird in the cage, etc., because habit has taught that it is the place for it. The principal object, however, is to place an image on both retinae at the same time and not let the patient lose the image in the amblyopic eye, or, so to speak we tease the defective eye into seeing. This we can facilitate by illuminating the picture seen with the amblyopic eye or darkening or dimming the other, by an illuminating device consisting of two lamp cups which are under individual control. This amblyoscope may be suspended from a wall bracket or a stand, the patient resting the elbows on a table and working the tubes in the lateral plane until the bird is in the cage or the mouse in the trap, etc. An adjusting screw is provided for correcting any vertical imbalance. In questioning the patient as to what he sees and the answer is negative as to the bird or mouse for the defective eye the illumination on this object is increased until it is visible. Children are often cunning and will sometimes answer to please you, but may be mislead by increasing or reducing the light thus eliciting a correct answer. This instrument has its faults since its operation depends upon the patient's answers with no chance for an objective check by the refractionist. In this respect the stereo-phorometer is superior since the operator can watch the patient's eyes while exercising. While these two instru-

ments embody virtually the same principles, the amblyoscope is doubtless superior for extending the range of fusion by using a group of pictures which demands fusion or super-imposition of images. F. and L. must be fused to form E. and so on through this group thus the fusional range is improved by increasing and decreasing the angle between the tubes in convergent and divergent strabismus respectively. The amblyoscope accomplishes quality fusion training better with stereoscopic pictures. The teasing into seeing of a amblyopic eye cannot be accomplished with the stereo-phoroptor since individual control for the light for the two eyes is not under control, but as soon as 20/40 or even 20/50 V. A. has been acquired, the case can be better handled on the stereo-phorometer since we have better control with it. Here we have compeltely set at rest the accommodation and this must be done when we wish to train the fusion sense and the innervation of the extrinsic muscles through the fusional or basal brain centers alone.

Development of Fusion

The phoroptor may be used very successfully provided it has been properly equipped. The stereo-phorometer has three cells, two 30° rotary prisms, a P. D. and spirit level adjustment, and has the cards four inches from the eye on the carrier. A plus 10.00 D. Speric lens is placed in each of the lens cells to compensate for the four inch distance. The patient is virtually looking at infinity now, and should wear his distance correction or it must be placed in the instrument. Since now the patient's accommodation is at rest, he shall also have no strain from overcoming phoria. The P. D. of the instrument should correspond to that of the patient, and the B1 card of the series is inserted. This group of cards is based on a distance of 60 m/m. Should the patient's P. D. be 60 m/m and he be orthophoric he will fuse perfectly the black disc having an arrow above it with the black disc in the horizontal row to the left marked 6. The patient should be directed to close the eyes each time the cards are changed in the holder. Should he report the arrow in card B1 or the central disc in B2 over 7 the eye should be closed and 5$^{\Delta}$ prism, base-in, turned in over each eye and again ask for a report. Perfect fusion with no strain may be attained either by decentering the plus 10.00 D. lens, the rotary prisms or with loose prisms, but decentering the plus 10.00 D. Sps. is best if the amount of prism needed is not too great.

Since either phoroptor or the stereo-phorometer may be used with an equal measure of success, it may be mentioned, in passing, may be brought into play. In using the phoroptor we may, however, excels in this work since, during the exercises, the prism jump system that the difference in the two instruments lies only in the possible adjustments. The stereo-phorometer may be raised or lowered to adjust either side higher or lower while the phoroptor cannot if the correction made up in it is a compound as the correct position of the cylindrical axes would be disturbed. Therefore, the stereo-phorometer or better still the kratometer should be used. The latter instrument

compensate for any amount of vertical phoria by correcting it with prism, base-up or down as is indicated, placed in the lens cell. Proceeding now with B2 card patient should report two discs above and two below the horizontal line of discs. Should three below or three above be reported we would have a case of vertical imbalance of 10° to be corrected by turning in a 10Δ prism base-up or down as the case may be and, when this is done, patient will report the cross perfect. Next, in this group of cards, is B3 admirably adapted for adjustment purposes and I prefer to use it right from the beginning. The right eye sees, on this chart, a black horizontal line numbered from 2 to 9 in spaces represented by 10° prism value for each space. The left eye sees a vertical red line having letters, also red, dividing it into spaces of 5° prism value, since the card is placed 100 m/m from patient's eyes. The adjustment now must be made so that the black line will cross the red and rest at 6 on black line and G. on the red one. With the B3 card any vertical phoria will at once show up.

The A. group, the first of the series, is a rather gross test for fusion and for any suspenopic tendency of either eye singly, and excellent work can be done with it in many cases especially those just emerging from amblyopia. The difficulty, however, lies in checking up the answers, but, by alternately occluding the eyes, now one, now the other, and checking the answers as to what is seen as well as the eye movements, good results may be had. A good idea can also be had, as to phoria present, by noting relative position of bird in the cage, but it is well to understand that fusion may not be dealt with, by using unlike objects in training.

The following is a good routine, but it is not the only one by any means, and it may not be the best, but excellent results will follow the use of it. Different refractionists will develop a technique of their own after using the Wells' system a short while.

Proceeding now we will use the C. group. Beginning in a gross way the ability to fuse is tested out.

C1. The two black horizontal rectangular fields should fuse into one and the smaller red and green fields above and below should be seen.

C2. The two eyes and ears of the hob-goblin should be seen. This chart generally brings a smile from the little folks and often from the grown ups. Should any of the parts be temporarily missing the patient's report will at once guide you in locating the suspenopsia.

C3. The staff, bearing Old Glory on each side, at once appeals to one's patriotism.

C4. A quite pathetic scene. Two butterflies each with one wing must be fused into a perfect one.

C5. The vertical rows of numerals, the middle row being common to both eyes and is the pivot point of fusion.

C6. This chart presents a man on a bicycle. The left eye sees

the lower half and the right eye the upper half, and the two parts are to be fused.

C7. The chart ON-NE has two red letters N and the letters must be fused together to form the word ONE having the one red letter N.

C8. Is an excellent chart in which it is required to fuse F and L into E. This is not hard to do, but, when the patient is asked to name the small letters in the vertical line of the E, the point of interest has been reached. Many will name the Z. Probably 50% will call the Y and 10% to 15% will call X. My own fusional faculties have been cultivated to the Nth degree, so to speak, but I cannot make the grade 100% at all times on this C8 chart. It is my experience that many people, otherwise normal, experience a slight suspenopsia upon elevating their eyes above the usual 15 degrees downwards visual direction, so I have come to believe that the difficulty experienced by many on this chart is a suspenopsia due to this elevation. I will endeavor to show this as true in a case record which I hope to give you, in another paper, at some future date, in which the left eye was carried from a condition of almost total blindness and hyper-exotropia of some 40° to orthophoria, easy comfortable fusion and better than 20/20 V. A. extending through a period of about one year of treatment. It is interesting to note the alternate appearance and disappearance of the small lines on C8 chart. This is due to the fact that their images appear in the fields adjacent to the macula in which there is a condition of ever changing suspenopsia.

C9. Is a chart which I value equally with any in the "C" Series. The pickpocket at work on the gentleman with the bee gum hat in block A. Placing the hands upon the watch to read 3 o'clock in block B. This one is quite difficult for many to do. The game of see-saw (sometimes called "teeter-tottering") with the dog gamboling, underneath, is very interesting to the young, and the figure in block I representing a spider web woven on the ground and seen, in the early hours of a crisp morning, while the dew is yet upon it.

Building Fusion and Relieveing Suspenopsia

The two series of charts E. and F. by Hale and Javal and others, are very valuable for both eliminating suspension and developing fusion.

E1. Must be seen as an inverted pail, larger at the top than at the bottom, and patient is looking at the bottom from the outside, and the black spots and circle are represented as being at various depths.

E2. The dish pan seen from the outside of the bottom which is seen as such.

E3. Is a pan seen by patient as looking down into it.

E4. Is a good one. This chart calls for nice work with the fusion sense since the perspective is deep and fusion is called upon to present a picture to the brain of a deep tunnel, though, what the retinae actually receive are but a few marks flat upon the paper and

these focused upon it at quite some distance apart.

E5 and E6. Though somewhat similar, present different problems for fusion to solve. Note the two arrows, in the former, are shown at some 7½ degrees inclination from perpendicular, in opposite directions, and each eye would have to rotate some 15 degrees to make them fall upon what we commonly call conjugate points. Since this cannot be done, when they have been fused, the patient sees one arrow pointing towards him, and this presents a phenomenon worth considering here. Suppose we view a rod or pole, rather near to us, which is pointing directly at the center of the nose crest. Just do this yourself for illustration. Close the right eye and the left eye sees the object from outer left to inner right and vice versa with the right eye, when the left is closed, and so in projecting the picture, when viewed with both eyes, we have the same condition shown on E5. It simply presents to the mind a remembrance of some past experience and fusion results. The arrows, in E6, work in a similar manner. These will, probably, not fuse, at once, but will soon appear as the upper pointing away and the lower toward the patient.

E7, E8, E9. Represent geometrical figures which will be fused into solid blocks.

E10. Is an exceptionally fine chart for testing perspective, since it shows objects which must be called according to their distances. These objects are seen at different distances, beginning with 5 as the nearest and are as follows: 3, 4, 9, 1, 7, 2, 8, 10, and 6 is the farthest. My reason for using the E. group first is that the objects are larger except in E10 and, from this, I can pass into the F. group and on into group G. which, for fine points of detail, cannot be excelled.

In F1, F2, F3. The word GOD is fused in ever decreasing sized objects in which care should be taken to have patient call all control marks, all of which are peculiar to the letters O. F4. fuses the word GID and these marks are in the letter I. F5 and F6 are the word GOID and have the control marks in the letters OI, the word being in smaller print or type thus calling for greater effort as to visual acuity and fusion. F7 is the last of this group with the word GICID and having a good many control marks.

The G. series is but a continuation of the F. but greatly amplified. The charts are made up of words and sentences, with many controls alternating on right and left sides, and when G8, and lastly G9 are reached some of the words are obliterated on the two sides in differing locations in such manner that they cannot be read unless both eyes are seeing and neither suspending to interfere with fusion. Constant vigilance is demanded of the patient to read the charts correctly and to call the control marks.

It is indeed interesting to, now, pass on to the I series of charts: This group is of especial value in training the extrinsic ocular muscles. The object of fixation is the word ONE, which is so divided as to present ON NE. In this division the two N's are colored red, and, when the ON NE is fused into the word ONE, the N's, only, are

brought together, and are seen as only one bright red N in the middle. Personally, I do not do all muscle training with the stereoscope, preferring the myoculator which method will be treated in detail in another article at some future time. The following is a good course of procedure and will prove successful for the refractionist who is not provided with any other means. Selecting the I. chart, marked 6 cm, which has a distance of 60 m/m between centers of the two N's, the patient should fuse it to ONE, readily, since we have previously set the instrument for 60 m/m P. D.

Muscle training may be done in quite a few different ways, and will be best accomplished when suited to the individual patient as well as refractionist. Let us take up convergence first. Place the I card, 6 cm. ON NE, in holder and have patient close both eyes and hold same thus occluded until you say "Open." While eyes are occluded turn in a weak prism base-out. Then say "Open," which patient will understand, through pre-arrangement, means to reopen the eyes. The operator will then say "Fuse," which has been explained to patient, and, when he has accomplished this he or she will often smile and speak out: "Yes, I have it, ONE," calling the word aloud in a voice indicating that pride is in the triumph. Then the operator repeats the request "close" and under this occlusion and with no change of charts, just a little more prism power is added, base-out and again the request: "Open." In this manner more and more prism power is thrown against the interni until the limit of resistance is finally reached. It can readily be seen that, in opening the eyes each time, a new and greater resistance has to be overcome in order to fuse the ON NE to ONE due to the fact that the two divisions of the word occupy new and unlike positions on the retinae, which necessitate the interni to contract and draw the eyes in in the act of convergence. Should the patient be unable to fuse the word on any reopening of the eyes, by pre-arrangement, he may speak the word "Two," when the prism power can be very slowly reduced until suddenly the letters will jump together. Since it is possible to present any prism power desired, to and including 30$^{\Delta}$ each, it is possible to use 60 degrees to stimulate the nerve centers which control the muscles, from this source alone. However, this is not necessary, as the I series of charts begin at 3 cm separation, center to center, and go to 11 cm., inclusive, thus giving you 7 charts from I. 7 cm. down for interni training and 5 charts from I. 6 cm. up to I. 12 cm. for external training. In using each card, in the manner so described, you need not use more than 5$^{\Delta}$ of your rotary prism since when the power has gone beyond this you can slip in a 5½ cm card and thus permit of a 5 degree prism reduction. It will be necessary to make the increase in prism added, during each period of occlusion, individualized as to the general physical condition of the patient, turning in no more than he can overcome to complete the act of fusion. It will be noticed that, upon opening the eyes and finding the letters broken, patient will be presented a sort of challenge, since, before occlusion, he had the letters fused and he will work very hard to

fuse them again. In this manner an amplitude of convergence fusion of 65 to perhaps 85 degrees may be built up.

You will find it best to permit the patient to work for a moment or two at the broken word, in the effort to fuse, before assisting him with prism reduction, for this fusing is exactly what we desire, and you will also note that the longer the period of occlusion the harder it is to fuse upon opening the eyes. Upon reaching the highest point of converging power, or at least a satisfactory one, we may now reverse the procedure and train the externi. It is done in a very similar way but with prisms base-in and with less increase during each period of occlusion. In this exercise we may begin with the I. 6 cm chart and go towards the I. 11 cm chart. In reaching the summit in both directions I would suggest that the same prism power be used two or three times with the last few occlusions. This will stabilize the condition and will tend to hold against ultimate loss of duction power, which is to be expected. Since the abduction is only about one-third that of total adduction, remember you are dealing with a much weaker muscle when training the externi, and a weaker prism jump must be thrown against them during each occlusion.

The optometrist will sometimes find a case that has difficulty in fusing without the median line, though these cases are rare. Such cases should be treated at an angle slightly to first one side and then the other. This can be accomplished by placing equal powered prisms in the cells of the instrument with both bases in the same direction, which, it will be readily understood, will shift the object ONE toward the vertices of the prisms, and this shift can be as much or as little as the power of the prism used will produce.

The fact that any case that I am training may be one of these "Median Line Fusers," to so speak, is one of my many reasons for preferrring the myoculator for muscle training.

When the patient has acquired a visual acuity of approximately 20/60 the operator should chose the chart that can be easiest fused and apply the prism with base indicated by the character of deviation, if any be present. There are cases of amblyopia to the extent of virtual blindness that can be brought to 20/30 or even 20/20 and no strabismus is present.

Cure of Persistent Suspenopsia

Dr. Wells has devised a reading control which is an improvement in clips, on the instrument, with instructions to use certain prisms with certain charts. In every case of home training you should hand your patient a tyepwritten sheet of instructions, giving in detail, carefully written explanation about the training for the home, and furthermore you should curtail this kind of training, using not too many charts. In fact it should never be carried beyond your office trainings at any period. Your office training may be stabilzed with correct home training, but you should bear in mind that the principal part of the cure of your patient must and will come from your office treatments.

The H. group is the last of these charts, and has controls for suspenopsia combined with the muscle exercises. In using this series, it is done in much the same manner as with I. series except that special attention should be given to the controls. See that the patient calls them.

I would like to remind you again, that the using of all these charts, with any one case, is not imperative. You should use just a few charts in each group, to learn what the anomaly is, and then use the series best adapted to the case.

Treating Children

It is indeed true that children's eyes are rarely ever correctly trained. When parents discover an anomaly with their children's eyes, they are content to console themselves by thinking, and many will so state, that the little one will "Grow out of it." This is a grave error, as we know, since most of these will but "grow-more-deeply-into-it."

Most children have been told stories of one kind and another and Dr. Wolf has given the profession a series of charts, which cover many of these children's stories. They are at once interesting and instructive. Most children are acquainted with the story and when they see it in pictures there is, at once, a psychological effect in connecting up his memory with the picture, and this assists greatly in the effort to fuse. These charts have the pictures spaced at various distances apart which enables the operator to make use of them in different cases. The color effect of the Wolf cards is such as to greatly assist in promoting fusional stimulus. Whenever possible The or A story, relating to the picture being used, should be told to the child while it is being used. This tends to cast from the child's mind any idea of being treated for his dreadful anomaly and surrounds him with an atmosphere of fun and pleasure instead and his parents will have no trouble getting him to return for subsequent treatments.

Home Training

It is impossible to cover the subject of home training, in this paper, since it is too extensive. So we will touch upon it but lightly here. Your patient's intelligence and co-operation will be the most important factors. If you can explain to your patient, or, if a child, to its parents, just what you want done and how often and GET it done, it will be of vast benefit, if not, then it will be a detriment, and had best not be attempted. Look well to the quality of the stereoscope your patient is to use at home, for most commercial instruments are out of alignment, and should be put in good shape before having them used. This, especially, as regards vertical imbalances.

I would advise that you test out your patient on the instrument you will give him for home work. You can do this by determining the easiest distance, with your B3 chart, and furnish him charts intended for use at this distance, or you may furnish extra prisms to be placed

over the instrument that was first introduced by Bull. It is very simple, yet very practical. It is not an expensive affair, yet it is surprising to note how little it is used. This instrument consists of an ordinary head band, of silk or metal, and to this is fastened, by a ball and socket joint, a band, of blackened aluminum, extending upward and curving over to a position vertically in front of the face and extending downward. At a point, above the line of vision for comfortable reading, this band is formed into three bands and these extend downward far enough to fully cover any reasonable area through which the visual line may pass. The central, of these three bands or prongs, is 10 m/m wide, the lateral ones 7 m/m and the spaces between them are 13 m/m. The band, curving up from the head band, is susceptible of easy bending, thus enabling the user to place the three flat bands or tines at a correct distance in front of his eyes. When these are placed at 15 cm. in front of the eyes, the fields of the two eyes overlap enough for comfortable reading, but in each line the control principle is brought into play three times. With a P. D. of 60 mm., with three prongs or bands at 15 cm. and the reading held at 14 in. (about 35 cm.) from the eyes, the overlapping is about 6 m/m. This, of course, increasing with the distance.

The older, single band, control is vastly improved upon by this triple control, especially in quiet reading, but necessitates more precise adjustment, and the latter may not be practicable for all near work. It is considered equally as effectual as Javal's "grill" in preventing suspenopsia.

In use the following conditions prevail. As one reads on, if either eye suspend, a black streak will be seen on the page instead of the print. This can be shown to the patient by having him close either eye alternately. If there be no suspension, all the print can be seen since stereopsis prevails. Should the patient occupy a conspicuous position he can only, use the control while in private, otherwise he may use it for all near work. Some complaint will be made at first, but the steadying effect is soon felt by most patients and their ability to use their eyes in comfort is greatly appreciated. It is obvious that these control exercises are for the patient's home or office use and not for your office.

The Use of Prisms

Within the last ten years I have prescribed prisms freely, and, at this time, have hundreds of patients wearing base-in prisms—quite a few in base-in-up combined with base-in-down prisms as the case required, and many in the vertical meridian. I shall never forget listening to a splendid lecture, delivered by Dr. R. M. Peckham in Minneapolis, only a year ago, in which he explained in detail the therapeutic advantages of base-in prisms, for constant wear, and vigorous base-out exercises mainly for the purpose of promoting a comfortable exophoria, with the former, and strengthening or steadying the interni with the latter. Dr. J. Neumueller, of Philadelphia, in his outstanding article, which appeared in The American Journal

of Optometry for August, 1928, covering the subject of Fusion Training, states verbatim: "The latter (prisms) should only be given when exercises are utterly impracticable, as, for instance, in old age, or due to the inability of the patient to attend the exercises." Further on, in the same paragraph, he wrote: "Whenever possible, exercising prisms have to be given the preference to relieving prisms, which latter ones very often tend to aggravate the condition." As regards Dr. Neumueller's two statements, quoted above, I wish to say that my own experience warrants me in taking friendly issue with him. The Doctor, continuing, states that Dr. Edwin Tait of the Pennsylvania State College of Optometry has worked out a formula which will give a good clue as to when to expect trouble from any present muscular imbalance. I am content, here, to refer you to his article in the Journal of the date mentioned above for your own perusal.

I wish to state, here, that I do not believe that any of us will find a single case of emmetropia if we spent a lifetime in searching for it, and, if it exists, there will be present also orthophoria or very apt to be. Now should we grant that no case of emmetropia exists, in verity, we therefore find a refractive error with every patient. This then impresses upon us the fact that the patient's eyes are functioning, during every wakeful hour, incident to habits governing them, in the scheme of vision, in his particular case. Just as soon as you refract that case and place correcting lenses before his eyes, for constant wear, you, at once, disturb those controlling habits and force the formation of entirely new and different ones, creating a condition in which fusion training is essential for the earliest possible attainment of comfortable vision under this new and different visual functioning. It is therefore incumbent upon us to search for conditions produced by placing correcting lenses on our patients, in each and every case, and apply the training, at once, which will most quickly inure him to the new order of affairs.

In conclusion, I wish to say that we should be very careful in determining just the kind of prism exercises to give, base in or out, since the phoria present does not always determine this. Undoubtedly the dynamic retinscopic findings will afford a most valuable clue, but muscle work must be determined upon as a result of the examination as a whole. Latent hyperopia almost invariably carries with it an esoporia. This may be functional or it may be true. Latent hyperopia will often be associated with exophoria, due to fatigue in interni innervation or externi inhibition. Should the dynamic retinoscope at 13 inches reveal latent hyperopia, base-in prismatic treatments are proper, regardless of what the phoria test shows. Only by a co-ordination of tests is it possible to solve the problems of the individual case. I know that every optometrist will profit very much in studying Fusion. I believe that at some time in the near future this very important work will be made a part of the exercises for young children in our schools, since most of them will, ultimately, fill positions in which their near fusion limits will be taxed to the utmost.

OCULAR ELECTROTHERAPY

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CHAPTER III.

CLASSIFICATION OF PHYSICAL AGENTS

Physical therapy is, as described in the first chapter, a complex system built for the application of certain physical agents in the treatment of pathological and physiological abnormalities. Under physiotherapy come all physical agents which are non-medical or surgical in nature. This would include massage, manipulation and exercises in all forms, all types of electrical treatment, all kinds of forms of heat and cold application, all forms of radiant energy including radium, X-ray, ultra-violet rays, the visible rays of the spectrum, and the infra-red rays, etc., mechanotherapy, occupational therapy, suggestion, etc.

In studying the list of physical agents enumerated here, we can see that there are some, which from their very nature are not only inapplicable to optometric practice, but are entirely and unquestionably outside of the field the practice of optometry covers. On the other hand there are other agents, which from their very nature would suggest themselves as applicable within the scope of optometry, as they are more or less the results, developments and achievements of applied physics of heat and light. We shall devote most of the space in the succeeding chapters in discussing this last group of agents which, we think, is of greater interest to the refractionist and we shall give only brief mention to some of the other agents merely to inform the reader of their existence and nature. Different authorities group these physical agents in various ways, but none of these classifications are absolute. They are mostly relative, as many of these agents will come under more than one head, especially is this true of Sampson's Classification[16] which is given with the aim of giving a quick general view of the various groups of physical agents. They come, he claims, in four groups as follows:

1. Thermal.
2. Chemical.
3. Mechanical.
4. Electrical.

Thermal. The agents coming under this head are three forms of heat—*Conductive, convective* and *conversive.*

Conductive Heat is best applied to the body by contact and is transmitted by conduction from heated substances to the body. These would include all such appliances as hot water bags, all kinds of hydro applications such as immersion baths, whirlpool baths, hot sand, hot packs, etc.

Convective Heat is heat thrown onto the surface from some outside source not in contact with the body, such as radiation coming from a lamp, heated air coming from electrically heated coils, gas or other burners, etc.

Conversive Heat is energy converted into heat inside the tissues themselves by virtue of the resistance of the tissues to the passage of high frequency oscillating current or heat waves passing through them.

Chemical. The physical agents coming under this heading would be the galvanic current, the effects of ultra-violet rays and certain X-ray effects.

Mechanical. Under this heading would come massage, mechanical vibration, manipulation exercises, effects of faradic currents, slow galvanic and sinusoidal and interrupted galvanic.

Electronic. Under this heading fall certain physical agents such as static electricity and other agents which may also come under the heads of chemical or mechanical.

Conductive and convective heat from natural resources for treatment purposes have been in use for many centuries. The effect of these two agents is to heat up locally the surface and superficial tissues to which it is applied. If this form of heat is applied very intensely, it will bring about certain reflex vasomotor changes which may benefit some distant parts. The more intense the local application, the more urgent is the call sent out to and through the parts to carry away as much of the heat as possible in order to prevent burns. Under these circumstances it is not possible to heat up the deeper structures by merely increasing the degree of heat and by prolonging the application. Radiant light is considered superior to diathermy for local surface applications.

Conversive heat, which forms inside the tissues and results from the passage of diathermy current through them, is by far the most efficient of all three forms of heat application. The formation of heat in this case is not on the surface but within the deeper structures. The depth of maximum heat can be varied by the size and positions of the electrodes. The effect and efficiency of conductive, convective and conversive heat, according to Sampson, are approximately in the ratio of one, five and one hundred respectively.

Electrotherapy, which is only one division of physiotherapy, may be divided under the following heads in order of their importance in ocular therapy:

1. Diathermy (high frequency).

2. Ultra-violet.
3. Infra-red.
4. Sinusoidal.
5. Galvanic.
6. Faradic.
7. X-ray.
8. Radium.
9. Millikens cosmic rays.

Diathermy is the production of heat within the tissues through the application of high frequency alternating current. This is a form of transformation of electric energy into heat energy.

Ultra-violet deals with the application of the actinic or chemical rays. There are the visible and invisible actinic rays. The visible, are those found on the spectrum from 3900 A. U. (angstrom unit) to 7000 A. U. The invisible, are found from 3900 to infinity. The visible rays have the property of heat and the invisible, particularly those in the near and middle ultra-violet regions, have as their property photo-chemical activity and are bacteriocidal.

The infra-red rays are also invisible and their chief property is the production of heat. The nature of this heat is altogether different from the heat produced by diathermy. The infra-red rays are found on the spectrum from 7700 A. U. to infinity.

The first three agents listed in the classifications of electrotherapy, namely, diathermy, ultra-violet and infra-red, are most adaptable for clinical use, and a considerable amount of clincal evidence is being accumulated which tends to prove that favorable results are obtained from the proper application of these agents in certain specific cases. In 1922 the Medical Research Council of England appointed a committee[17] to study the biological action of light, and as a result of this investigation, an ultra-violet eye clinic was instituted at the Royal London Ophthalmic Hospital.

The next three agents of this classification, namely, sinusoidal, galvanic and faradic currents have not been applied clinically to any great extent. Drs. Massey and Morse have recently written a very instructive book on this subject which contains a chapter on the ocular application of galvanic and other low voltage currents, suggesting technics to be used in specific cases.

D'Arsonval,[18] while repeating the work of Ward in alternating frequency currents, discovered not only diathermy, but also sinusoidal currents as well. He also was one of the first to advocate its application for therapeutic purposes. This type of current is of special value where muscular contraction and cellular massage is desired.

A sinusoidal current is defined as an induction current of low frequency, small volume, and short phasic duration, capable of producing muscular contractions which are uniform, rythmic, and painless.

In the earlier days when instrumentation was crude and un-

developed, sinusoidal and faradic currents were overlapping each other in the therapeutic field. With the recent development of perfected apparatus of low inductive currents, this overlapping is now a thing of the past. The sinusoidal current possesses the property of *contracting* and *decongesting* action which is of considerable value from a clinical standpoint. Recent laboratory and clinical experience has given us clear-cut pictures of the physiologic action of both faradic and sinusoidal currents. Faradic current is of great diagnostic value in testing early nerve degeneration. Its therapeutic effect is questioned, and it lacks the properties of restoration of muscle tone which sinusoidal current possesses. Hallender and Cottle state that sinusoidal current is of distinct advantage because it is practically painless when administered to a part, and because it is capable of exerting its effect without even slight electrolytic action. Its uniform, smooth, rythmic and wave-like action makes possible its application without ill effects even to such sensitive organs as the eyes.

A galvanic current possesses certain therapeutic properties which are of importance and deserve close study of the clinical results. The galvanic current possesses a positive and negative polarity. One pole is positive and the other is negative. The electrode when attached to the positive pole produces entirely different effects on animal tissues than the electrodes attached to the negative pole.

Through the use of galvanic current various kinds of chemicals can be introduced into the tissue substances. The positive pole is acid in reaction and sedative in effect. It is a vasoconstrictor, because it hardens and contracts the tissues. It possesses the power of arresting hemorrhages, dehydrating and drying of tissues, and allaying inflammation. The negative pole is alkaline in reaction, irritant in effect. This pole is capable of softening and relaxing tissue. It is a vasodilator, tending to increase hemorrhage. The value of galvanic current as a therapeutic agent has been studied clinically only within recent years. Its application to the eye is still in the experimental stages.

The last three agents of the preceding electrotherapy classification at the present state of development are not applicable to the eye from a clinical standpoint.

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[The Production of High Frequency Current will be discussed in the next chapter.]—EDITOR, AMERICAN JOURNAL OF OPTOMETRY.

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[16]C. M. Sampson, The Practice of Physiotherapy, p. 39.

[17]H. S. Hoffman, Some Modern Advances in Therapeutics, The Eye, Ear, Nose and Throat Monthly, January, 1929, p. 591.

[18]Hollander and Cottle, Physical Therapy in Disease of the Eye, Ear, Nose and Throat, p. 39.

A QUESTIONNAIRE ON THE ASSOCIATED FUNCTIONS OF CONVERGENCE ACCOMMODATION AND FUSION

In the effort to broaden our understanding of the associated functions of convergence and accommodation the following questions were sent to Dr. M. Steinfeld and several other men whose outstanding work in ocular myology makes their views on these matters of the utmost importance and we believe of the greatest interest at this time. We will publish in subsequent issues the views on these questions, of other of our practitioners.

The questions are as follows:

What is the relation between esophoria (excessive convergence) at the near point in the young adult and high exophoria (convergence lag) in the presbyope?

Is the one the forerunner of the other? That is, can we expect the young adult with excessive convergence at the near to have convergence lag of high amount at the near when he becomes a presbyope?

If not, why is it, that convergence excess at the near is the common imbalance found in the young while convergence lag is usually associated with the presbyopic period. Why is it, that the percentage of convergence excess cases found among young patients dovetails with the precentage of convergence lag cases found in the older ones? Why is it, that the young patient who shows a convergence excess is as a rule the ardent, energetic, "doer" type and this also holds true of the average presbyope who shows a convergence lag? Are these facts mere coincidence or do they point to the fact that convergence excess at the near in the young adult presages convergence lag in the prebyope?

If it can be demonstrated that the convergence excess of the young adult turns into the convergence lag of the older patient, what is to be done about it?

We know that uncorrected hyperopia, hyperopic astigmia, over corrections of minus, prism power base-out, wide interpupillaries and pathology cause excessive convergence. What other factors are causative?

Does a convergence excess at the near always keep company with a faulty, incomplete, or imperfect fusion sense?

If so, is it this lack of positive binocular fixation or anchorage, associated with faulty fusion, which permits the development of a

convergence lag when the accommodation no longer functions unaided at the near point?

Further, what factors contribute toward the conversion of a convergence excess into a convergence lag? We know that over-corrections of plus, especially reading corrections for presbyopes, and base-in prism power gradually bring about convergence relaxation, which can result in a convergence lag. What other factors produce this result? Do small segment bifocals tend to cause convergence lag by the disturbing effect they may have or near point fixation? Are large segments conducive to easier near point vision when there is a convergence lag present?

If prism power base-in only tends to convert one distressing condition (convergence excess) into another (convergence lag) over a period of years, is it not questionable procedure to use such prism power either for wear or exercise without close and constant supervision of the case? Should not the use of such procedure always be accompanied by fusion training?

Is correction of a faulty fusion sense the surest and sanest way to establish comfortable ocular balance? If so, should not all orthoptic training stress the development of greater fusion power?

These questions are asked with the view of clearing up the haze surrounding the whole question of ocular imbalances. We believe that the group mind of our leading optometrists can solve the problems of ocular balance and set our feet upon the pathway of clarity and established facts.

Dr. M. Steinfeld reviews the above questionnaire and comments thereon in the pages immediately following, (pages 169-171), while a few notes on this same subject from the pen of Dr. Withers Bagwell will be found on pages 193-194 of this issue. For the reader's convenience the following Reference List of previously published manuscripts in answer to this questionnaire is given:

Convergence. Accommodation and Fusion. Dr. I. S. Nott, American Journal of Optometry. Vol. 6, No. 1, pp. 19-29. 1929.

Convergence, Accommodation and Fusion. Dr. J. I. Pascal. American Journal of Optometry. Vol. 6, No. 2, pp. 102-104. 1929.

CONVERGENCE, ACCOMMODATION AND FUSION

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The haze surrounding the subject of ocular balance, is due in a large measure to the belief that the ocular functions are very complicated, and the effort is made to prescribe treatment for them on this basis. If the question of accommodation and convergence is stripped of all except essential facts, it will be more easily understood and treated. The editors of the American Journal of Optometry are to be commended for their efforts to clear this haze, and we are glad to assist by answering their questions to the best of our ability.

We (both Dr. Steinfeld and his son are optometrists) do not believe that esophoria at the near point in the young adult is in any sense the cause of convergence lag in the presbyope. The same conditions which cause the esophoria in youth, may when accommodation is no longer active, be the cause of the exophoria in age. The esophore of youth may become the exophore of age, but there is no reason to believe that he is going to have high exophoria at the near point when he becomes a presbyope because he shows esophoria when young.

We do not find convergence excess the common imbalance in the young as implied in the question, nor do we believe that the percentage of convergence excess cases in the young, dovetails with the percentage of convergence lag cases in the older ones, although we have compiled no figures. To do so we must first decide what to consider convergence excess and what convergence lag. It has been accepted as true that from three to five prism diopters of exophoria at the reading distance is normal lag. We find a greater number of our young patients showing more lag than this instead of less after correction of their hypermetropia, and we therefore believe that we have not corrected all of the latent hypermetropia. We know in most cases that the energetic "doer" type will show an esophoria at the near point, because he is in a state of tension, but we have never noticed convergence lag especially common in this type of presbyope.

With from three to five prism diopters of exophoria at the near point accepted as normal lag, we do not find a great precentage of our young patients showing convergence excess. We find the majority of our presbyopic patients showing from five to twelve prism diopters of exophoria at the near point, and having no trouble because of it. Those showing more than twelve are likely to complain in sus-

tained close work although many presbyopes with fifteen prism diopters, experience no trouble. We would therefore conclude that exophoria as much as ten prism diopters at the near point in presbyopes, need give no concern.

We do not believe that a faulty, incomplete, or imperfect fusion sense keeps company with a convergence excess any more often than it does with a convergence lag. In fact we do not consider an apparently poor fusion sense a cause of ocular imbalance as often as it is an effect. An apparently poor fusion will improve with orthoptic training which restores binocular balance, without any special fusion training.

We have given little study to the effect of the size of segments of bifocals on convergences. In our experience our patients prefer large segments and seem more comfortable with them. Those who have used small segments and changed to large ones seem more comfortable with the larger. Since the preference is for large segments, we prescribe them as a rule.

We do not prescribe prisms base-in for constant wear for the purpose of relaxing convergence excess, so are not in a position to judge of their danger. We have used instead oculo-prism treatments with prisms base-in which technic has proved successful. We believe that constant supervision should be kept in all cases under treatment for binocular imbalance. The lag which follows the wearing of prisms base-in, given to relax over convergence, is probably the effect of the weak convergence which was one of the causes of the apparent convergence excess.

The principal cause of over convergence in the young is, as we know, hypermetropia. Weak convergence, weak accommodation, or a too close interlocking of accommodation and convergence are strong contributing factors. Few people have a sufficiently strong convergence for the needs of modern life. It is not true, as generally believed, that over convergence denotes a strong convergence. In fact most of these cases lack sufficient convergence power, and are helped by convergence training. It is the assistance rendered by accommodation to a weak convergence which causes the apparent over convergence.

We prescribe prisms base-in for constant wear, in cases only where exophoria is of such an amount that binocular vision is in danger of being lost. We find in these cases that prisms base-in accompanied by convergence training will restore an apparently lost fusion sense without special fusion training. We believe that exercises for fusion training are valuable in any type of imbalance. Whether or not they actually develop fusion, they help to increase speed of adjustment and relative convergence.

The remedy for our convergence excess and our convergence lag, lies in the proper treatment in the young; the correction of the hypermetropia, the training of convergence, the increase of the relative

convergence, which is the ability to use the functions of accommodation and convergence independently, and the development of speed in adjustment of accommodation and convergence.

The proper orthoptic treatment which breaks the close interlocking of accommodation and convergence, and creates speed of adjustment, also enables us to correct the latent hypermetropia. The customary exercises for developing fusion are helpful in increasing the relative convergence. A good exercise is the use of letters instead of an object or light for a fixation object at twenty feet. With the full correction on, the smallest letters that can be read are selected. Oculo-prism treatments with prism base-out are given, the patient being instructed to keep the letters as clear as possible. If the eyes are fully corrected, and are trained to keep the letters readable with as much as twelve or fourteen prism diopters base-out, the convergence is usually working sufficiently independent of accommodation to prevent over convergence.

With the proper habits of convergence developed in the young, we need not fear the effects of convergence lag when presbyopia comes.

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ADVANCES IN OPHTHALMOSCOPY

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No diagnostic instrument plays a more important part in the examination of the eyes than does the ophthalmoscope. The optometrist who does not use it with care and thoroughness does not have the interest of his patient at heart; neither is he sure of the ground he is working on. Yet very few who use it have kept abreast with the latest discoveries of its uses and technique, being contented in their superficial examination of the arteries and veins in the vicinity of the disc, the macular area, the size and color of the disc, and the appearance of the media.

To me, as an optometrist, the systolic blood pressure as found at the brachial artery is of less importance than that pressure existing in the retinal branch of the ophthalmic artery. While it is true that the pressure of the blood is distributed equally to all parts of the arterial system, it is not consistent that the pressure exerted on the walls of the vessels from without is equal in all parts of the body. I mean by this statement that the pressure (external) exerted on the walls of the vessels of the retinal arteries due to the intra-ocular pressure is not similar to that pressure found in the stomach, lungs, etc. Hence, as vision depends absolutely on retinal circulation, we must consider this as a distinct function as far as the eye is concerned in comparison with the other organs of the body. Therefore I am particularly interested in the retinal blood pressure and circulation.

Baillart, in his recent work entitled *"The Retinal Circulation"* has introduced a method whereby, with some practice and skill, we are able to detect an abnormal tension of the retinal arteries and veins; just as we can detect by palpation an abnormal intra-ocular tension as found in glaucoma. His method is to examine by means of the ophthalmoscope the retinal arteries and veins just where they curve out in their course to or from their entrance or exit at the disc, and at the same time he exerts a slight pressure on the eyeball which causes a pulsation of the arteries or veins. The pressure necessary to induce pulsation of either the arteries or veins is indicative of the nature of the intra-ocular tension and the arterial and venous pressure respectively.

I have used the following method for exerting pressure on the eyeball. Having adjusted the head rest so that the patient's eyes are directly in line with the border of the wall and ceiling of the

room, the operator, using one hand to hold the ophthalmoscope, presses gently inward at a point just below the margin of the lower lid with the index finger of the other hand.

The amount of pressure necessary to induce pulsation, first of the veins and second, of the arteries, will vary directly as to age. I have found that with children very little pressure is needed to disclose pulsation. In many cases where the intra-ocular pressure is approximately that of the venous pressure we have a physiologic pulsation of the veins. If we increase the intra-ocular tension by finger pressure this pulsation irons out. However, an arterial pulse when seen without finger pressure is never physiologic and such cases should be handled with care as they sometimes indicate a tendency toward glaucoma or a cranial disorder. After an arterial pulsation has been induced by finger pressure, still greater pressure will suppress this pulsation. The amount first necessary to induce the pulsation is known as the diastolic pressure and this amount combined with the amount necessary to suppress the pulsation is known as the systolic pressure. A variation in the amount of pressure in any or both of these two stages from the normal amount indicates hypertension.

The value of determining whether hypertension exists is unlimited. *Retinal hypertension generally goes hand in hand with systemic hypertension.* One of the first signs of albuminuric retinitis is an increased tension of the retinal arteries. In optic neuritis there is also a slight increase in the tension of the retinal arteries. Bailliart states that "The most formidable danger of retinal hypertension is hemorrhage. Though retinal hemorrhage rarely comes from the arteries still hypertension in the arteries means hypertension also in the capillaries and veins; and these vessels support increased pressure with difficulty." So it seems that we have a new diagnostic field open for us.

In closing, I wish to call your attention also to the new method of holding the ophthalmoscope. This is known as the "Modified Dean Technique with the Ophthalmoscope" and is described fully in all angles by Skeffington in his new book entitled *"Procedure in Ocular Examination."* This method of holding the ophthalmoscope gives us a stationary picture of the entire fundus under ideal conditions and, in conjunction with the above mentioned method of diagnosing hypertension is, I believe, invaluable.

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A SUGGESTED METHOD OF DESIGNATING THE POSITION OF PRISM BASES

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At the present time there seems to be no method whereby the position of the base of a prism is designated without some written qualifying statement. For example, if we wish to incorporate, in a prescription, a prism of 2Δ base-in, we now must write as follows:

(1) O. D. + 0.25D Sph⊃ + 0.50D Cyl. Axis 90⊃2Δ base-in.

If now we had a condition where we desired 2Δ base-up and in at axis 75, our prescription would now be:

(2) O. D. + 0.25D Sph⊃ +0.50D Cyl. Axis 90⊃2Δ base-up and in axis 75.

Quite recently, the idea occurred to me that a shorter and much better way than the present one now in use, was possible if we employed the following system: Inasmuch as the accepted symbol for prism dioptre is Δ, which in itself represents a prism, why, then, should we not carry the idea further in these two respects: (a) Heavily line or underscore that side of the symbol to represent the

FIGURE ONE.

(1)+0.25 D.Sph.⊃+ 0.50 D.Cyl.axis 90⊃ 2▶

base of the prism, thus for example, Rx No. 1 above, would now be written as in Figure One. In this way the written expression "base-in" is both eliminated and understood. In like manner, base-out, base-in, base-up and base-down would be indicated as shown in Figure Two. (b) In cases where we come up against a condition such as to require a prescription similar to No. 2, it would be written as in Figure Three. This to my mind, is an improvement over the written word instruction system.

Summary

The present system of indicating the position of the base of a prism, in a written manner, is made unnecessary by the shorter and more technical substitution of symbols alone.

Under this new system both the position and base of the prisms

FIGURE TWO

Base-out

Base-in

Base-up

Base-down

FIGURE THREE

(2) +0.25 D.Sph. ⊂ +0.50 D.Cyl.axis 90 ⊂ 2 axis 75

is signified by the accentuation of one of the sides of our present accepted prism dioptre symbol. When any particular angle is desired, this is expressed as we express cylinder axis.

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A FAMILY CASE HISTORY SHOWING SUB-NORMAL ACUITY OF VISION IN ONE EYE

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I had the occasion to refract the eyes of five members in one family not so very long ago, which gave me a good opportunity to study and to prove what bearing heredity may have upon the eyes.

The mother, age 47. Her health was fair although she was subjected to severe headaches. Had been wearing lenses of various foci which were not satisfactory. She complained that both distance and near vision was very poor. Visual acuity, uncorrected 8/200. My final correction was O. D.+ 6.00 D. Sph. ⊃ + 0.50 D. Cyl. axis 60, O. S. + 5.50 D. Sph. ⊃ + 0.75 D. Cyl. axis 120. O. D. add + 2.00 D. Sph., O. S. add + 150 D. Sph. With the following correction her visual acuity was distance O. D. 20/200, O. S. 20/40 + O. U. 20/30. She was also able to read the newspaper type with a fair degree of comfort.

Two months later her four children were sent in to me. Two sons, twins, age 13. Never had worn glasses. The first, Joseph, health O. K. with the exception of slight nervousness, complained of distance vision. Fundi normal. Visual acuity uncorrected, O. D. 20/50, O. S. 20/70—. Static skiametry, O. D. + 3.00 D. Sph. ⊃ + 0.75 D. Cyl. axis 90. O. S. + 2.50 D. Sph. ⊃ + 1.00 D. Cyl. axis 90. My subjective test compared favorably with my static skiascopic findings with the exception of a slight reduction in the sphere in O. D. The visual acuity with the correction remained about the same, although relief with the lenses before the patient's eyes was very much in evidence. Because of his dislike of glasses and of a nervous temperament I prescribed the subjective findings.

The other son, Paul, was a little harder to refract. Had intermittant convergent squint, although the right eye was the dominating one. Visual acuity, uncorrected, O. D. 20/20—. O. S. 20/70. My final correction for him was O. D. + 1.00 D. Sph., O. S. + 3.00 D. Sph. Fundi normal.

Daughter Lorine, school teacher, age 24. Complains of eyes aching, trouble at near, frontal and occipital headaches. Had been refracted in 1921. Correction unknown and lenses had been worn but very little. Fundi normal. Becomes nauseated very easily. Visual acuity, uncorrected, O.D. 20/20—, O.S. 20/30 + .5$^{\Delta}$ esophoria.

Dynamic skiametry O. D. + 1.50 D. Sph. ⊃ + 0.50 D. Cyl. axis 90, O. S. + 2.75 D. Sph. Final correction O. D. + 1.00 D. Sph. ⊃ + 0.37 D. Cyl. axis 90, O. S. + 1.75 D. Sph. Visual acuity corrected, O. S. 20/20, O. S. 20/20—.

Daughter Ruth, student, age 18. Had never worn glasses. Distance vision was questionable, that is, patient saw clearly and then complained of a slight blurriness temporarily, and also complains of near vision. Has frontal headaches. Squints her lids. 1$^{\Delta}$ esophoria. Visual acuity, uncorrected, O. D. 20/20, O. S. 20/30. Fundi normal. Objective and subjective tests agreed very well and my final correction was O. D. + 0.25 D. Sph. ⊃ + 0.50 D. Cyl. axis 105, O. S. + 0.75 D. Sph. ⊃ +0.50 D. Cyl. axis 90.

The unusual thing about these five cases is that, the mother had fairly good visual acuity with her correction in the left eye and the visual acuity of the right eye was poor, although the corrections were very much the same. In all four of her children, quite the contrary, the left eye proved to be the poor one, although the corrections for the two eyes in each case do not vary very much.

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AN ATTACK OF GLAUCOMA PRECIPITATED BY A FAULTY DIAGNOSIS AND TREATMENT—A CASE HISTORY

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Case No. 2961. Mrs. Mary H—, Age 62 years. Housewife.

On February 17th, 1929, patient telephoned that she had suffered a total loss of vision in the right eye and asked that I see her immediately. On arrival at the office a few minutes later she volunteered the information that she had been undergoing treatment at the hands of a local oculist for the past five weeks and, in her own words, "had paid him and fired him" earlier in the day.

Patient's family history as to cataract, glaucoma or blindness was negative. Five years ago she was treated for what was then diagnosed as a retinal hemorrhage in the left eye. Two years ago she had some marked swelling in both eyes that was diagnosed and treated as "a cold in the eye." Has had rheumatism for some four years past for which she received treatment from her family physician. Some nine months ago she ventured the remark to her doctor that she "believed her rheumatism was affecting her eyes" and he advised her to consult her oculist, which she did, complaining of failing near vision that was accompanied with sharp ocular pain and the annoyance of flashes and halos about lights. At this time the following lenses were prescribed for her which she was wearing when she called at my office. O. U. plus 0.50 D. Sph. with an addition of plus 3.50 D. Sph. for near work. These were made up in fused bifocals and mounted in a well fitted frame. At no time during the past five years has the oculist told her that she was developing a cataract.

Five weeks ago the patient returned to the oculist complaining of cloudy near vision and a great deal of ocular pain. At this time the lids were swollen and the conjunctiva greatly congested. This was again diagnosed as "a cold in the eyes" and a solution of atropine prescribed—to be instilled in eye four times a day. (The writer was able to check up on this prescription and verify the drug used.) The patient reported weekly and each time was told to continue with the drops, despite the fact that her suffering had increased and that she was obviously becoming worse. This continued until she consulted me.

When at the conclusion of our examination we urged an immediate hospitalization, we learned that the patient had a great deal

of extra work and worry during the past six weeks, due to the fact that her husband was confined to the house with a fractured leg, and that some permanent deformity was expected to result. Our examination revealed the following conditions:

Right Eye—Visual acuity (with or without glasses) was limited to a faint light perception. There was marked edema and swelling of the lids. Many sub-scleral and sub-conjunctival hemorrhages. Marked chemosis. The pupil extremely and irregularly dilated. The reflexes were absent. With loupe and condenser the greatly distended and tortuous veins of the iris were easily seen and the presence of many minute hemorrhages noted. A well advanced cataractous lens had pushed forward and greatly diminished the depth of the anterior chamber. Practically the whole of the cornea was "steamy" and presented the greenish reflex so characteristic of glaucoma. There was marked corneal anaesthesia. Under these conditions a view of the fundus was impossible. The globe manifested so marked a resistance to the palpating finger that tension was recorded as T = plus 3. Later, at the hospital, the tonometer registered tension as T = 75 mm Hg.

Left Eye—Vision without glasses was .8. With glasses (plus 0.50 D. Sph.) vision was 1.0. There was some congestion of the sclera and conjunctiva. Pupillary reflexes sluggish to both light and accommodation. Media clear. There was a marked tortuosity and sclerosis of the retinal vessels, a slight yellowish discoloration of the disc, and a slight, but well defined, cupping of the disc, the vessels appearing to bend sharply over the margin to reappear much fainter in the bottom of the cup. The perimeter showed a moderate contraction of the fields in the superotemporal quadrant.

A tentative diagnosis of acute congestive glaucoma was made and the patient informed that immediate hospitalization was imperative. Because of her husband's condition this was postponed until the following morning when her daughter came home to care for the father. I immediately telephoned the chief of the eye clinic at the hospital where our medical and surgical cases are sent, acquainting him with the facts in the case. He telephoned a prescription for pilocarpine solution to the druggist and instructions to me, to be passed on to the patient, as to its use. Patient was admitted to the hospital the following morning and diagnosis confirmed and intensive treatment instituted in an effort to save the eye. On admission there was profound depression and the patient suffered agonizing pain. At this time, two days later, there is a marked improvement and the prognosis is favorable. This emphasizes the necessity of prompt action and treatment in such cases and the advantage of an early and correct diagnosis.

This patient, suffering from a long standing rheumatism and increased arterial tension (blood pressure systolic 210) which, with the increased pressure due to a maturing cataract, plus the nervous

reaction due to worry about her husband's condition, made conditions ideal for the precipitation of an attack of glaucoma by instilling atropine. The narrowing of the perilenticular space, which accompanies the dilatation of the pupil, was apparently sufficient to entirely close an already narrow filtration angle in a patient at an age, and in a condition, where mydriasis was obviously contraindicated.

The history and condition of this patient being known to the oculist, the failure to promptly and correctly diagnose, and the subsequent use of atropine, appears inexcusable.

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AMERICAN JOURNAL OF OPTOMETRY

VOL. 6 MARCH, 1929 NO. 3

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Published Monthly by the
American Journal of Optometry Publishing Association.

The Journal has no objection to the reprinting by other magazines of any of its articles, provided such reprints are properly credited to the American Journal of Optometry.

MINOR OCULAR SYMPTOMS OF EXOPHTHALMIC GOITRE

The three principal symptoms of exophthalmic goitre are, first, increased rapidity of the heart's action; second, a tumefaction of the thyroid gland; and third, an exophthalmos, usually bilateral.[1] In addition to these principle or what might be termed cardinal symptoms there are various other ocular diagnostic signs which are frequently of assistance in making a diagnosis. Before passing on to the minor symptoms it might be well to mention that exophthalmos, which is an abnormal protrusion of the globe of the eye is found in from eighty to ninety per cent[2] of exophthalmic goitre patients, usually those cases where the enlargement of the thyroid has progressed materially. However, it is well to remember as Holloway *et al* point out in a paper on this subject presented before the section of ophthalmology of the A. M. A.[3] that, as unmistakable as exophthalmos may be when it is well established, the fact remains that in certain cases it may be difficult to say whether or not it is actually present. This exophthalmos, is according to Werner[4] caused by a hyperemia of the retrobular orbital tissues, as is, he claims, demonstrated by a vascular bruit often present, and the fact that steady pressure on the globe temporarily diminishes the protrusion. The minor symptoms of exophthalmic goitre are as follows:

Ocular Versions

The versions of the globe of the eye are usually good in these

cases in the earlier stages of the disease but as this progresses the versions in the lateral direction are frequently affected, a large percentage of patients showing a marked muscular imbalance, some even having a paralysis of one or more of the extrinsic ocular muscles.[5]

Von Graefe's Sign

Von Graefe's sign consists in an impairment of the consensual movement of the upper lid in association with the eyeball. When in the normal condition, the globe of the eye is rolled downwards, the upper eyelid falls, and thus its margin is kept throughout in a constant relation to the upper margin of the cornea. In most cases of exophthalmic goitre the descent of the upper lid does not take place, or does so imperfectly; and consequently, when the patient looks down, a zone of sclerotic becomes visible between the margin of the lid and the cornea. This symptom is, according to Werner,[6] tolerably constant and almost pathognomonic. It also is frequently present before any exophthalmos and hence has great diagnostic value. Fox[7], however, denies that it is pathognomonic claiming to have observed this sign on the eyes of healthy individuals. According to Holloway,[8] "the lack of co-ordination between the movement of the upper lid and the elevation or depression of the visual axis or plane is also susceptible of variable interpretation. In his original descripition von Graefe stated that the usual coincident following of the upper lid was almost entirely held up or reduced to a minimum in exophthalmic goitre. So it is in the excessive cases, but there are other instances in which the cornea is still well covered that, we believe, illustrates this phenomenon. Von Graefe also pointed out that, when the exophthalmos was slight and equal, it was difficult to say when the lid movement was pathologic. When examining for this sign, the eye of the observer should be on the same plane or slightly below that of the patient's eye. The frontalis muscle should be completely relaxed; if contracted it will probably accentuate an existing sign or produce a slight von Graefe when none actually exists."

Dalrymple's Sign

The Dalrymple sign consists of a retraction of the upper eyelid so that there is an unnatural degree of separation between the margins of the two lids. The widening of the palpebral fissure produces the peculiar stare which is frequently present in patients with exophthalmic goitre.[9]

Stellwag's Sign

Stellwag's sign consists of imperfect power of winking or diminished frequency in the act of winking. DeSchweinitz[10] describes this by saying that in these patients one frequently notices that there will be a number of very rapid winks succeeded by a long pause in which there is no movement of the lids, or that each time that the winking occurs it is not complete and the margins of the lids do not, as in the normal eye, come together. Ball[11] claims that the von

Graefe, Dalrymple and Stellwag signs should always be carefully sought for in any thorough ocular examination, claiming also that the later is caused in part at least by a lessened reflex irritability of the cornea and retina.

Mobius' Sign

A diminution of binocular convergence or the Mobius' sign is sometimes present in these cases of exophthalmic goitre and causes the patient to suffer the usual symptoms of asthenopia.[12] At times there may even be a complete loss of convergence,[13] though Swanzy[14] feels that this is nearly indicative of general nervous debility, and not of importance as a sign of exophthalmic goitre.

Kocher's Sign

Kocher's sign is a retraction of the upper lid when the patient fixes a stationary object, or a convulsive momentary retraction of the upper lid when a vertically moving object is fixed. Holloway[15] claims that the first phenomenon is frequently seen, especially in the toxic patients with well defined exophthalmos and the Dalrymple's sign.

Lagophthalmos

An inability to close the lids or a lagophthalmos due to the protrusion of the globe of the eye. This symptom will be only found in the most advanced cases of exophthalmic goitre.

Edema of the Lids

An Edema or swelling of the lids is occasionally apparent in cases of goitre. This condition is according to Holloway[16] most frequently found in the upper lid manifesting itself as a fullness of the upper lid most conspicuous above the tarsus or just encroaching on its upper borders.

Conjunctivitis and Excess Lacrimation

Conjunctivitis and lacrimation are common in cases with marked exophthalmos. The conjunctivitis, is according to Ball,[17] due to diminished sensibility of the conjunctiva and imperfect nictitation, (winking). Ball, quoting Berger claims that the lacrimation and epiphora are due to stimulation of the sympathetic nerve, causing increased secretion from the lacrimal gland.

Arterial Pulsation

DeSchweinitz quoting Becker[18] claims that spontaneous arterial pulsation is frequently present in these cases being a symptom of exophthalmic goitre. Werner[19] claims that this condition is exceptional, while more recently Holloway,[20] found in a rather large group of goitre cases that more than 40 per cent of the patients had this symptom. Holloway feels that this is so important that he says, "in the absence of signs of glaucoma, the detection of an arterial pulsation demands a determination of the basal metabolism."

These diagnostic signs, while naturally not to be found in all exophthalmic goitre cases, are found in a sufficiently large number of cases to make their discovery important whenever uncovered in the course of a routine optometric examination. Patients with these symptoms after having their refractive needs taken care of, should be kept under observation by both the optometrist and the consulting family physician. C. C. K.

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ABSTRACTS

VISUAL ACUITY AND ILLUMINATION. S. Hecht. Archives of Ophthalmology. Vol. LVII, No. 6, pp. 564-573. Six Figures. 1928.

Hecht reviews the work done by Koenig (1879) and then that done by Roelofs and Zeeman in attempting to find the exact relation between visual acuity and illumination. Hecht then attempts to explain the dependence of visual acuity on illumination. This he does by referring to the rods and cones of the retina, claiming that the rods are sensitive to low illuminations outside of the foveal area and the cones, situated all over the retina but very densely in the foveal area are sensitive to higher illuminations and are receptors for color.

Beginning, he claims, with the lowest illuminations vision is a function of the rods. The number of rods which are active is very small; this amounts to having a resolving surface with the receiving elements sparsely distributed. The retinal distance between two just discriminable contours must be large, and visual acuity is very low. As the illumination increases, more and more rods reach their threshold and become functional, with a resulting increase in visual acuity. Presently an illumination is reached when the first cones begin to function. Visual acuity will still be mediated by the rods because there are still more active rods present than cones. But the rate at which the cones come into play with increased illumination is nearly ten times as great as the rate of the rods. Therefore at a certain point the number of cones functioning in the fovea will be equal to the number of rods in the periphery. As the intensity increases beyond this, the number of active foveal cones per unit area will be greater than the number of active peripheral rods in a unit area, and visual acuity will now be determined by the cones. This augmentation of the number of functional cones and the resulting rise in visual acuity will continue until all the cones are active and no further change in visual acuity is possible.

His conclusions are as follows:

1. Visual acuity varies in a definite manner with illumination, being low at low illuminations and high at high illuminations.

2. These variations in visual acuity measure the variations in the resolving power of the retina. The resolving power of a surface like the retina depends on the number of elements per unit area. Changes in visual acuity then presuppose that the number of elements in the retina is variable. This cannot be true structurally; it is therefore assumed functionally.

3. It is assumed that the thresholds of the rods and the cones are distributed in relation to illumination in a statistical manner similar to other populations. A quantitative treatment of such a supposition is shown to describe the data of acuity accurately.

4. The visual acuity of completely color-blind eyes are shown to follow the deductions from this explanation.

5. Further analysis shows that color, form, and brightness vision may all be considered as properties of minimal retinal areas containing about 540 cones.

T. O. B.

ULTRA-VIOLET RAYS. W. E. Dixon. The American Journal of Physical Therapy. Vol. 5, No. 9, pp. 401-404. 1928.

Dixon, in writing on the general physiological action of the ultra-violet ray upon the body, says that the skin acts as a partial screen to the different wave-lengths of light. Luminous rays can pass through several centimeters of the body, but ultra-violet rays penetrate much less, and all but the very longest are absorbed by the epidermis. The infra-red waves also, he claims, have little power of penetration. Within this area of the spectrum penetration varies with the wave-length, being greatest with the red waves of light and least with the short ultra-violet rays. Ultra-violet light, he believes, therefore, cannot have a direct action on deeper tissues.

Sunlight, ultra-violet rays, and infra-red rays all cause the skin to turn red at first, and, if the dose is repeated or prolonged, to become pigmented later. If the skin of a man is exposed to a powerful carbon arc the irritant effect, as shown by redness, can be largely screened off by ordinary glass; light passes through glass, but ultra-violet rays are held back. On the other hand, a plate of quartz glass through which ultra-violet rays pass has no influence in limiting the inflammatory reaction, which may remain for several days and be followed by peeling and pigmentation. Ultra-violet rays are largely responsible for the inflammatory reaction, although sunshine is more effective in influencing the extent and duration of pigmentation. Pigmentation from lamps is more superficial and transient than that produced by sunshine; it is a natural protection against the treatment, and, he claims, we do not yet know whether its production is an advantage or a disadvantage to the patient.

Apart from the action on the skin, ultra-violet radiation gives a feeling of well-being and vigor. Many other effects on metabolism have been ascribed to ultra-violet rays, but Dixon does not believe that most of these are specific.

T. O. B.

DYNAMIC RETINOSCOPY. G. Lea. The Optometric Weekly. Vol. XIX, No. 30, pp. 1065-1067. 1928.

Lea in this paper attempts to show that the difference between the dynamic and static skiametric findings are due to the over corrected aberration by accommodation, and he divides the considerable difference between dynamic and static findings in young people into two portions traceable to—

(a) Peripheral accommodation.

(b) Central aberration.

By peripheral accommodation is understood the flattening of the periphery of the crystalline lens, causing the over-corrected aberration shown by Tscherning's experiments. The term "central aberration" is confined to refraction within a radius of (approximately) 1.5 mm. from the center of the pupil during accommodation.

The reason why, he claims, the function of accommodation refuses to be numerically expressed by a theoretic deduction is surely to be sought in the dynamic elasticity of the ciliary muscle. This elasticity is made manifest by the highest plus and minus sphericals through which near type is clear at a given distance, for the purpose of measurement of the relative amplitude. It constitutes, he continues, the normal "play" of ciliary adaptation for all near work, the focusing adjustment of the dioptric system of the eye, responsive to the requirements of retinal conjugation, and operated through the ciliary ganglion by the ophthalmic division of the third nerve.

T. O. B.

THE ROLE OF HEADACHES IN EVERY-DAY PRACTICE. L. W. Oaks and H. G. Merrill. The Eye, Ear, Nose and Throat Monthly. Vol. 7, No. 8, pp. 415-419. 1928.

This is a well written thesis on the subject of headaches, all types being mentioned. Headaches due to ocular disorders are covered by the authors in the following manner:

"In the category of eye troubles, there occur several conditions which produce headache. From the standpoint of refraction, astigmatism and hyperopia are the main offenders, along with the various ocular muscle disturbances, chief among which are hyperphorias and exophoria. Contrary to the usually accepted notion, headache from refraction errors is rarely present when the individual awakens in the morning. These factors usually create a frontal headache which is bilateral and likely to come on during the middle or latter part of the day. Pain behind the eyes and through the eyeballs is common; but the notion that occipital headache is the usual thing from eyestrain is probably erroneous. Distress in the occiput is usually from some other source. Astigmatism against the rule is a prolific cause of

ocular headaches; and if we are to give relief to such patients we must go to the extreme in correcting even minute errors. As little as twelve one hundredths dioptre of hyperopic astigmatism has been known to cause the most distressing of oculo-refractive head pains, which disappeared immediately upon applying correcting lenses. Certainly this is not true of astigmatism with the rule, since many persons of rugged health will carry one dioptre or more of this type of error without particular suffering.

" 'Panoramic headache' is a term used to denote a type of cephalalgia produced by riding in a rapidly moving train or automobile and watching that part of the passing landscape which is near at hand. This may also be quickly acquired by standing near a passing train and attempting to make out its detailed characteristics. Effect upon the ocular muscles is supposed to be responsible for panoramic headache. A person with low convergence amplitude or who has a hyperopia is most likely to suffer from it.

"Ophthalmic head pains may result from excessive exposure to light. Many people who are more than normally sensitive to light develop headaches from long car rides in the bright sunshine, or from traveling in any fashion under a Western summer sun. Even the less sensitive retina will seriously object to the offense of facing for long an unshaded window, which serves as an important source of light for the room. The almost continuous frontal headache suffered by some teachers in the public schools may often be traced to such an etiology.

"Glaucoma and iritis, as well as pan-ophthalmitis, are obviously capable of setting up head pains of marked severity. Where either condition occurs in one eye only, the pain may begin in the affected side, deep in the eye and along the anterior part of the side of the head. As its severity increases, its area may extend until it involves the whole cranium. Dr. John Green of St. Louis has reminded us that: 'Persistent, dull headaches in elderly persons may, and frequently do, have glaucoma as its basis.' "

T. O. B.

TOXIC FOCI IN CASES FOR REFRACTION. A. F. MacCallan. The American Journal of Ophthalmology. Vol. 11, No. 10, p. 815, 1928.

MacCallan reported clinical observations on a series of one hundred private patients. The series was commenced in August, 1927, and included all private patients examined who could be improved by glasses to the usual standard of normal vision. During the period under survey thirty-nine other patients were examined whose vision could not be improved to the normal on account of obvious pathological changes in the eyes. The ocular changes which have been shown to be associated with conditions of focal sepsis are numerous,

but those noted in this series of cases were blepharitis, episcleritis, opacities in the vitreous seen with the slit-lamp, opacities of the lenses as seen by ordinary focal illumination, and changes in the retina in the region of the macula.

After investigation the conditions of sepsis in the body calling for surgical intervention were found to be appendicitis one case, enlarged septic tonsils two cases, suppurating antrum one case. The cases of dental sepsis were more numerous, forty-two patients being referred to their own dentist for treatment at the discretion of the dentist. Of these cases radiographs of the whole mouth were made in thirty-three patients, with the result that the appearances which are characteristic of apical abscesses were found in twenty-two of them. Most of these abscesses were shown to have been actually present by extraction of the diseased tooth, though many other teeth were condemned by the dentist which on extraction were found to have the apices infected. There was also one case of a dental cyst with apical abscesses in which the bone of the mandible was dangerously thin.

The patients were almost entirely drawn from the upper middle class, which made the dental findings much more striking than if they were drawn from a hospital clinic. To find twenty-two cases of apical abscess among one hundred private patients who came to an ophthalmic surgeon for glasses seemed to indicate the need for an increased use of radiography by dentists and increased suspicion of every dead tooth.

T. O. B.

CASE OF WOOD ALCOHOL BLINDNESS WITH EXCAVATION OF DISC. J. Friedenwald. The American Journal of Ophthalmology. Vol. 11, No. 9, p. 725, 1928.

Friedenwald presents the case of a colored man, aged thirty-five years, who was on a drinking bout from November 1 to 5, 1927. On November 6 he felt no worse than he had after similar experiences, but on the seventh he was seriously ill with headache and nausea. In the morning his vision was not impaired, but at noon the sight began to fail, and in a few hours all light perception was lost. He was first seen on the following day, when he was mentally clear and showed no toxic constitutional symptoms. There was slight divergent strabismus, pupils dilated and fixed, slight congestion of the retinal vessels with slight edema of the retina about the disc. Chemical examination of the blood and urine revealed normal figures. Repeated lumbar punctures were performed without any improvement. Three weeks later the disc began to pale. At the present time the right optic disc was bluish white and showed a deep pseudoglaucomatous excavation with dipping of the retinal vessels at the margin of the disc. The left eye also showed a white disc but only a shallow

depression. The patient had been repeatedly examined since the onset of his trouble and had never shown a rise in the tension of the right eye. Throughout the period of convalescence the patient had shown a most remarkable visual phenomenon. There was no light perception and no pupillary reaction to light. In spite of this, the patient was able to recognize hand movements before the left eye and to identify the direction of the motion. He was able to do this even when his face was shielded by a plate of glass from any air currents. He recognized the movements better in dim light than in bright light. No explanation of the curious visual phenomenon was offered.

T. O. B.

A CASE OF HIGH MYOPIA. D. T. Hartley. The Optometric Weekly. Vol. XIX, No. 42, p. 1494, 1928.

Hartley presents a case of a myopic patient, male, age 52, whose vision was very poor, but who had never used a correction. After having the case under observation for some time, Hartley prescribed the following corrections which gave him 20/60 vision for distance and enabled him to read with comfort.

Distance correction:
O. D.—25.00 D. Sph.
O. S.—29.00 D. Sph.

Reading correction:
O. D.—22.00 D. Sph.
O. S.—24.00 D. Sph.

C. C. K.

A CASE OF IRREGULAR ASTIGMATISM AND FAILURE OF ACCOMMODATION. W. Heap. The Optician, (British). Vol. LXXVI., No. 1928, p. 225. 1928.

Heap presents the following case of a patient, Mrs. J., age 47 years, housewife, who stated that, "the left eye had been misty since she was 18 years of age, or possibly earlier, but it had not troubled her until the last four years. Her 'bad eye' now appeared to be causing a lot of strain in the R. E., because close work became increasingly difficult, until it had become quite impossible, except when wearing spectacles obtained 6 months ago. These spectacles, the only pair she had ever had, were obtained at the hospital, and when she was being tested, the doctor was very puzzled, and called in three others who also examined her eyes, and did not seem to know what was wrong."

The Rx was R.E. +2.50 S., L.E. plano.
The V.A., without glasses, was R. 9/9 ? ? L. 4½/60.
The fundi appeared normal, but difficult to examine in the L.E.

because of a considerable amount of lenticular abberation, and slight opacity of the lens due to sclerosis.

Objectively the R.E. gave +0.75 Cyl. 145°. L.E. typical irregular astigmatism. Subjectively the patient accepted: R.E. +0.50 Cyl. 1.50° 9/9, L.E. nil.

+3.00 Sph. was required before the R.E. to read J 1 at 30 cms.

There was hardly any amplitude of accommodation.

The patient had enjoyed good health and was quite strong and full blooded. She had two children; a boy age 18 years, a girl age 22 years, and although both were engaged on close work (clerk and dressmaker), neither had complained about their eyes. An aunt on the maternal side had "gone blind" when about 50 years of age (cause unknown).

The irregular astigmatism was, according to Heap, as far as could be ascertained, completely lenticular, a condition which was evident, before the ciliary processes were fully matured. This could have been caused by malformation of the lens itself, or malformation or attachment of the ciliary muscle and zonule of zinn.

Heap is of the opinion that the original trouble lay in the ciliary muscle, or zonule of zinn, causing unequal traction on the lens before it was fully matured. This had then caused the accommodative action to be gradually suppressed in the L.E. for two reasons, viz., a clear image could not be obtained and the eye became amblyopic, and malnutrition of the ciliary due to faulty attachment. Now that the muscular power of the ciliary in the R.E. is considerably less (due to age), the inactivity of the ciliary processes in the L.E. has reacted sympathetically and inhibited the accommodative power of the R.E. However, says, Heap, the chief argument against the above postulation is the following question: If the cause of the failure of accommodation in the R.E. was sympathetic, why was there not a similar interference with other muscles working sympathetically and using the same nerve supply (6th motor oculi), e. g., internal, superior inferior recti and inferior oblique, or sphincter pupillae? There was little phoria present and pupillary reactions were normal for light reflex, but weak for accommodative reflex.

T. O. B.

IS CONVERGENCE PRIMARY OR SECONDARY TO ACCOMMODATION? G. D. Oertel. The Columbia Optometrist. Vol. 2, No. 3, pp. 7-9. 1928.

The author briefly reviews the subject of accommodation and convergence, claiming that convergence is a primary function and that accommodation is a secondary function, following convergence as a reflex.

C. C. K.

CONCOMITANT STRABISMUS AND HETEROPHORIA. K. R. Smith. The British Journal of Ophthalmology. Vol. XII, No. 11, pp. 581-591. Illustrated. 1928.

No case of squint will exist when binocular vision can be produced claims Smith in a paper on concomitant strabismus and heterophoria. He advocates the clinical use of the Binoscope, a device somewhat on the order of a stereoscope to develop first binocular vision and later the fusion sense. Treatments of this nature are, he claims, at times even successful in adult cases.

T. O. B.

CASE OF IRITIS DUE TO FOCAL INFECTION OF DENTAL ORIGIN. R. H.Lieberthal. Bulletin of the New York Optometric Society. Vol. 5, No. 10, pp. 5-6. 1928.

Lieberthal presents a case of ocular inflammation due to a focal infection in the tissue around the upper left first bicuspid. Patient, Mrs. X, presented herself with a condition of iritis with the following history: Sinus condition, left eye closed, swelling, in the year of 1920. Septum was removed same year. 1924 re-occurrence, not accounted for, 1926 re-occurrence, not accounted for. An examination and thorough check up by ophthalmologist eliminated any systemic focus of infection except the teeth. Upon dental examination of the most exhaustive kind, the tissue surrounding the upper left first bicuspid was found to be abnormal, the lining surrounding the root of the tooth known as the peridental membrane was partly absorbed. Tests proved the tooth to be vital, in so far as nerve reaction was concerned. It was decided to remove the bicuspid tooth, clean and pack the socket, establishing a drainage. Upon removal of the tooth, the root of same was found to be in an absorbing condition. The eye condition cleared up within two weeks. Up to the present there has been no re-occurrence.

T. O. B.

PHOTOPHOBIA. H. B. Marton. The Optician, (British), Vol. LXXVI, No. 1962, p. 190. 1928.

Marton claims the fundamental causes of photophobia are (a) Lack of harmony of ciliary action. (b) Heterophoria, mainly vertical, and (c) Diseased conditions.

T. O. B.

ANNOTATIONS AND SOCIETY PROCEEDINGS

The American Journal of Optometry is the official Organ of the American Academy of Optometry, as well as the Organ of the Arkansas, Delaware, Iowa, Maine, Maryland, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Pennsylvania, South Dakota, Vermont and West Virginia Optometric Associations.

The following gentlemen have consented to supply items of interest from their respective sections, acting in the capacity of

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CONVERGENCE ACCOMMODATION AND FUSION

Dr. Withers Bagwell of South Boston, Virginia, author of the monograph on *Blue Lenses and Their Use in Cataract Cases,* in a recent letter to the editor of this Journal comments at some length on the relationship between esophoria at the near point in a young adult and high exophoria in the presbyope. Dr. Bagwell claims "Fundamentally plus lenses suppress accommodation. These, through the accommodation-convergence centers likewise suppress convergence. The average presbyope therefore is wearing suppression lenses constantly, and therefore is likewise habitually suppressing convergence. Whether this actually results in exophoria later, depends largely on how much esophoria there was to be overcome and possibly exceeded."

He continues: "An orthophoric emmetrope in youth accommodates ½ D. for vision at 80 inches and 3 D. for vision at 13 inches. The same individual, at 58 years of age, wearing bifocals of 2.50 D. Sph. addition, would never need more than the ½ D., even at 13 inches; using only as much accommodation as he would have needed in youth for 80 inches. In other words, his ciliary is never taxed beyond ½ D. After wearing suppression lenses for years and years, is it any wonder that the negative, relative convergence should "lag?" It seems to me it would be a wonder if it did not do so. I cannot agree that the ciliary is as busily active in the presbyope as it was prior to presbyopia. If the presbyope went entirely without glasses, the surmise would be unassailable, but with bifocals gradually and progressively supplanting most of the needed accommodation, there

is neither need nor incentive for ciliary activity beyond a narrow limit. If accommodating ½ D. fully accomplishes clear vision at the nearest working point, the ciliary *never exerts itself beyond that amount,* and consequently lapses into almost total inactivity. While the nucleus of the lens is hardening with advancing years, there remains, not only cortically but anteriorly and posteriorly, enough resilent substance to readily secure the needed additional convexity to produce ½ D. of accommodation until well into old age, and this would be the ultimate demand behind a reading segment of 2.50 D. Sph. addition. With the increased addition for near, as he grows older, the presbyope uses less and less accommodation, getting progressively less and less nerve stimulus to the ciliary and by the normal convergence-accommodative asociation, less and less nerve impulse to the convergence."

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MINNESOTA ANNUAL CONVENTION

The annual convention of the Minnesota State Association of Optometrists was held at the Nicollet Hotel, Minneapolis, Minnesota, February 10th to 15th. The first several days were taken up with technical talks by Dr. A. M. Skeffington and Dr. J. C. Copeland, as well as by the usual routine business of the delegates. Following the convention proper, a class of more than thirty assembled for four intensive days of clinical work under Dr. Skeffington's direction. This was Minnesota's first participation under Dr. Skeffington in the Graduate Clinic work, all of which impressed the men very favorably.

An elaborate banquet, arranged by Dr. A. H. Nordland, and presided over by Dr. A. C. Hoffman, closed the convention proper. The newly elected officers are as follows: Dr. C. C. Koch, President; Dr. H. Watzke, First Vice-President; Dr. E. E. Jones, Second Vice-President; Dr. N. M. Klaers, Third Vice-President; Dr. E. W. Follendorf, Fourth Vice-President; Dr. A. H. Nordland, Secretary; and Dr. H. W. Norden, Treasurer.

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NEW JERSEY ANNUAL CONVENTION

The annual convention of the New Jersey Optometric Association was held in Newark, on January 23rd. The chief speakers were Dr. Edwin F. Tait of the Pennsylvania State College of Optometry, Dr. Clifford L. Treleaven of the School of Optometry, Columbia University, and Dr. Chas. H. Sullivan of Camden, a recipient of the honor award at the last meeting, presented one of the finest educational programs ever given by the association.

Dr. Tait, speaking on "Practical Methods in Ocular Anomalies and Their Treatment," brought out many interesting and new developments in muscle work. He illustrated many conditions of imbalance which optometrists are confronted with in their daily practice,

and gave examples of how to overcome some of them for the comfort of the patient.

Dr. Treleaven spoke on "Retinoscopy" and illustrated his lecture with the aid of stereopticon views. A description of this instrument and its importance in refractive routine were taken up by Dr. Treleaven. He dwelt on some recent developments in conjunction with its dynamic use and the easy method of ascertaining a comfortable correction for the patient.

Dr. Sullivan, in his discourse on "Modern Optometry," told the members of the new ideas that have been successfully applied in optometry through the various research methods, the instruments now available for determining the proper correction.

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NEW YORK ACADEMY OF OPTOMETRY

Dr. Willard B. Fisher of White Plains, New York, was elected president of the New York Academy of Optometry at its annual election held at the Waldorf Astoria. The other optometrists elected to office are: Dr. Irwin W. Quinn, Vice-President; Dr. Franklin A. Seward, Secretary; Dr. Willis Blockwell Blee, Treasurer. Dr. Harvey Lyons was elected to the Board of Directors.

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NEBRASKA ANNUAL CONVENTION

The annual convention of the Nebraska Association of Optometrists was held at Lincoln, and included one of the best educational meetings ever presented to the optometrists of this state. Dr. Carl F. Shepard, Chicago, gave an interesting lecture on "Ocular Myology." A talk was given by Roy O. Pennock, Lincoln, on "Business Analysis as Applied to Optometrists," which brought out many points of value to the optometrists. The educational sessions continued with a lecture by Dr. C. R. Ellis of the optometry department of Ohio State University. His subject was "Disturbance of Vision Peculiar to Old Age." Dr. J. C. Copeland, Chicago, spoke on "Retinoscopy." Ray C. Kingsley, Omaha, spoke on "Examining Board Progress," touching upon recommendations for future laws and board regulations. Round-table talks were given by the following speakers: J. P. Miller, "Suppression of Treatment Cases"; George Parkins, "Reduction of Myopia"; C. A. Perrigo, "Dynamic Skiametry"; O. J. Melvin, "Recommendations of the American Academy of Optometry," and Roy Moore, "Confidence of Patients." Dr. Roy S. Dean, Kansas City, Mo., lectured on "Stereoscopic Development of the Fusion Faculty." The session ended with the election of officers which resulted as follows: Charles S. Dixon, North Platte, President; L. C. Stoll, McCook, First Vice-President; Edwin B. Ackerman, Fairbury, Second Vice-President; John F. Ayers, Lincoln, Secretary-Treasurer.

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